USAID | LEBANON
FROM THE AMERICAN PEOPLE

LITANI RIVER BASIN MANAGEMENT SUPPORT PROGRAM

LITANI RIVER FLOOD MANAGEMENT REPORT (EXTRACT)

SEPTEMBER 2012
This report was produced for review by the United States Agency for International Development (USAID). It was prepared by International Resources Group (IRG) under Contract EPP-I-00-04-00024-00 order no 7.

LITANI RIVER BASIN MANAGEMENT SUPPORT PROGRAM

LITANI RIVER FLOOD MANAGEMENT REPORT (EXTRACT)

SEPTEMBER 2012

Contract No.: EPP-I-00-04-00024-00 order no 7.

TABLE OF CONTENTS

ACRONYMS

UN	United Nations
%	Percent
cm	Centimeter(s)
km	Kilometer(s)
M	Million
US$	United States Dollars

1. CONTEXT

The Litani River Basin drains the Central and South Bekaa Valley. The valley is sandwiched between Mount Lebanon to the west and the Anti-Lebanon mountain range to the east. Winter precipitations fall heavily on both ranges and engender heavy flows which then spread across the valley whose bottom is almost flat and with a low north-south slope. Floods are thus common occurrences in the valley but with the development of human activities (farming and urbanization), their impacts are increasing.

2. FLOODS AND FLOOD MANAGEMENT PRINCIPLES

Storms and floods are natural events and have both positive and negative effects on human well-being. High flows and flood waters are needed to cleanse channels of accumulated debris, build stream banks, deposit nutrients in the floodplains, recharge aquifers and sustain riparian habitat.

But storms and floods also cause direct/physical damages (due to submersion and water flows) and indirect damages (disruption of human and notably economic activities). With population growth and economic development, more and more infrastructures and human activities settle or take place in floodplains and thus get impacted by floods.

Text Box 1 Sustainable Flood Prevention Guidelines

Seven basic principles and approaches:

- Flood events are a part of nature.
- Human interference into the processes of nature has increased the threat of flooding.
- Flood prevention should cover the entire catchment area.
- Structural measures will remain important elements of flood prevention and protection, especially for protecting human health and safety, and valuable goods and property.
- Everyone who may suffer from the consequences of flood events should also take precautions on their own.
- Human uses of floodplain should be adapted to the existing hazards.
- In flood-prone areas, preventive measures should be taken to reduce the possible adverse effects on aquatic and terrestrial ecosystems.

UN/Economic Commission for Europe, 2000

While managers and engineers are quick to go for structural solutions such as embankments and dams to address flood concerns, these solutions are:

- **Dangerous**, as they give a false sense of security, while absolute protection does not exist, there may always be a larger/stronger flood (than the design flood) that will cause extensive damage; and
- **Expensive**, while there should be a comparison between the cost of flood protection works and the cost of potential damage.

In most situations, more emphasis needs to be given to natural solutions (such as flood expansion areas) and nonstructural approaches (such as smart urban planning).

3. FIELD SURVEY

The main findings are that the Litani River Basin suffers from three types of flooding:

- **Flooding from the Litani River and Major tributaries (Ghzayel, Berdawni, Jair-Hafir)**; this is due to natural floodplain characteristics, compounded by lack of riverbed maintenance, existence of obstructions such as insufficient road bridges and irrigation weirs or other illegal constructions in the riverbed, dumping of all type of solid and hazardous waste, etc.
- **Seasonal flooding from minor channels (Howayzek, Oqeyber, Faregh)** mostly due to lack of agricultural drainage; this is due to the impermeability of soils (mostly clayey), and poor maintenance and disappearance of many drainage ditches in farm lands; and
- **Local flooding in urban areas (Bar Elias, Marj)** during winter rains for lack of storm/sewage networks.

The flood of February 2003 was found as historically significant because:

- It is one of the two largest floods in human memory, in addition to possibly 1968;
- The flood caused significant damages:
  - Thousands of hectares of cultivated areas in the Beqaa valley were inundated
  - The West Bekaa was transformed into a series of isolated islands only accessed by the mean of boats or heavy trucks
- It is a recent flood and hence the collection of field information from residents is possible;
- Discharge and level data is available for this flood (from LRA gauging stations)

It was thus used as design flood to calibrate the flood model, assess floodable areas, recommend flood mitigation measures and design flood protection works.

4. HUMAN ACTIVITIES INCREASING THE IMPACTS OF FLOODS

Through the field survey and flood analysis, several types of improper human practices and mismanagement were found to exacerbate flood extent and damages:

- Lack of maintenance and vegetation growth in riverbeds
- Direct dumping of solid waste and worksite debris in waterways the riverbed
- Presence of improperly designed bridges or culverts with undersized openings
- Tampering with riverbeds and banks: construction of farmer diversion weirs, ponds and pump sumps, local levees, etc.

Specific bottlenecks are insufficiently sized bridges, where backwater impacts can elevate upstream water levels by 30 cm and much more. Most of these bridges with insufficient sections are situated in the upper part of the Litani river in addition to secondary tributaries such as Howayzek, Oqayber and Faregh.

5. FLOOD MAPPING

Using a computer model, three sets of maps covering the central Bekaa valley from Rayak to Joub Jenine have been established:

- One for the 10-year flood (10% probability of happening any year, and about 70% of 2003 flows) where flooding is limited to:
  - The Litani River banks upstream of the Damascus highway;
  - Some areas along the Howayzeh, reaching Bar Elias around the Damascus highway;
  - West of the Litani River immediately downstream of the Damascus highway (at the junction with the Chtoura and Berdawni); and
  - Some local areas around and downstream of the village of Haouch el Harime.
- One for the 25-year flood (4% probability of happening any year, and about 85% of 2003 flows), where flooding is more widespread:
  - All along the Howayzeh from Dalhamiye to Bar Elais;

  - Along the Damascus highway; and
  - Between Haouch el Harim and Mansoura.
- Finally one for the 2003 flood, which confirms the observed flooding, a 2-3 km wide area along the Litani River from Dalhamiye to Mansoura, impacting mostly Bar Elias, Marj and Haouch el Harim.

In all flooded areas, different levels of depths have been identified (0-20cm, 20-50cm, 50-100 cm, 100cm+) to inform about increasing flood intensities.

6. RECOMMENDATIONS FOR FLOOD PROTECTION AND MITIGATION

The flood management approach is that:

- **Protecting all areas for all types of floods is impossible** since there can always be a larger flood than the one used to design protections, and can quickly become expensive when it involves infrastructure works; and
- **Protecting urban areas should be the priority** while rural areas should be kept as expansion areas (flood volumes need to go somewhere and cannot be simply channeled through).

Flooding damage can be prevented or at least significantly mitigated with simple foreseeing urban planning measures. The following recommendations are meant to enhance the safety of persons, limit the damage to property and the nuisances for human activities, while ensuring the free flow of water and the conservation of areas designated for flood expansion. They consist of prohibitions on land use and requirements and recommendations to prevent damage:

Table 1 Prohibitions on Landuse; and Requirements and Recommendations to Prevent Damage

Flooded zone with flooding higher than 20cm	Where	Urban development	
		Allowed	**Should be avoided/prohibited**
A: Urban centers	Centers of Bar Elias, El Marj and Haouch El Harime	Any new buildings, but basements should be avoided. For commercial and industrial buildings, the functional levels should be above flood levels.	Sensitive equipments/buildings such as electric transformers, hospitals, etc.
B Peri-urban	Regions around Dalhamieh, Bar Elias, El Marj, Er Raouda and Haouch El Harime	New buildings but areas lost to large commercial/industrial buildings should be compensated (landfill should be taken from the same plot)	Sensitive equipments/buildings such as electric transformers, hospitals, etc.
C Farmlands, rural areas	Most of the Litani river valley	Buildings and facilities used for agricultural purposes and outdoor recreation (parks, gardens, sport fields, etc.) Areas lost to large landfills should be compensated.	All other types of construction (residential, commercial, industrial). Embankments along the river and other works preventing flooding.

For all new constructions in flooded areas, real estate developers should be informed of the potential risks at the time of delivery of construction permit and in turn inform their buyers.

Some infrastructural works are suggested in order to protect the most sensitive urban areas:

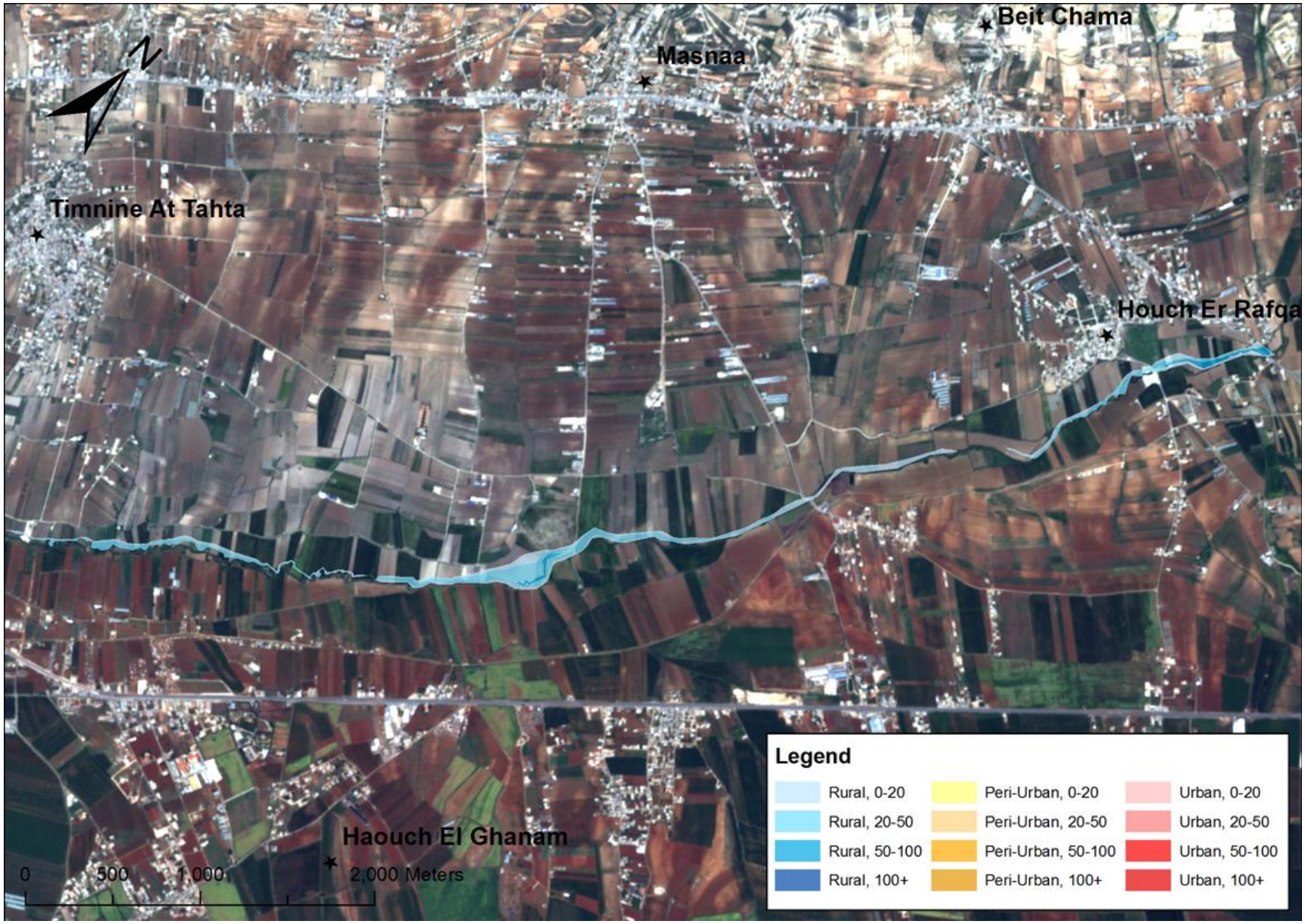
Table 2 Infrastructural Works Suggested to Protect Most Sensitive Urban Areas

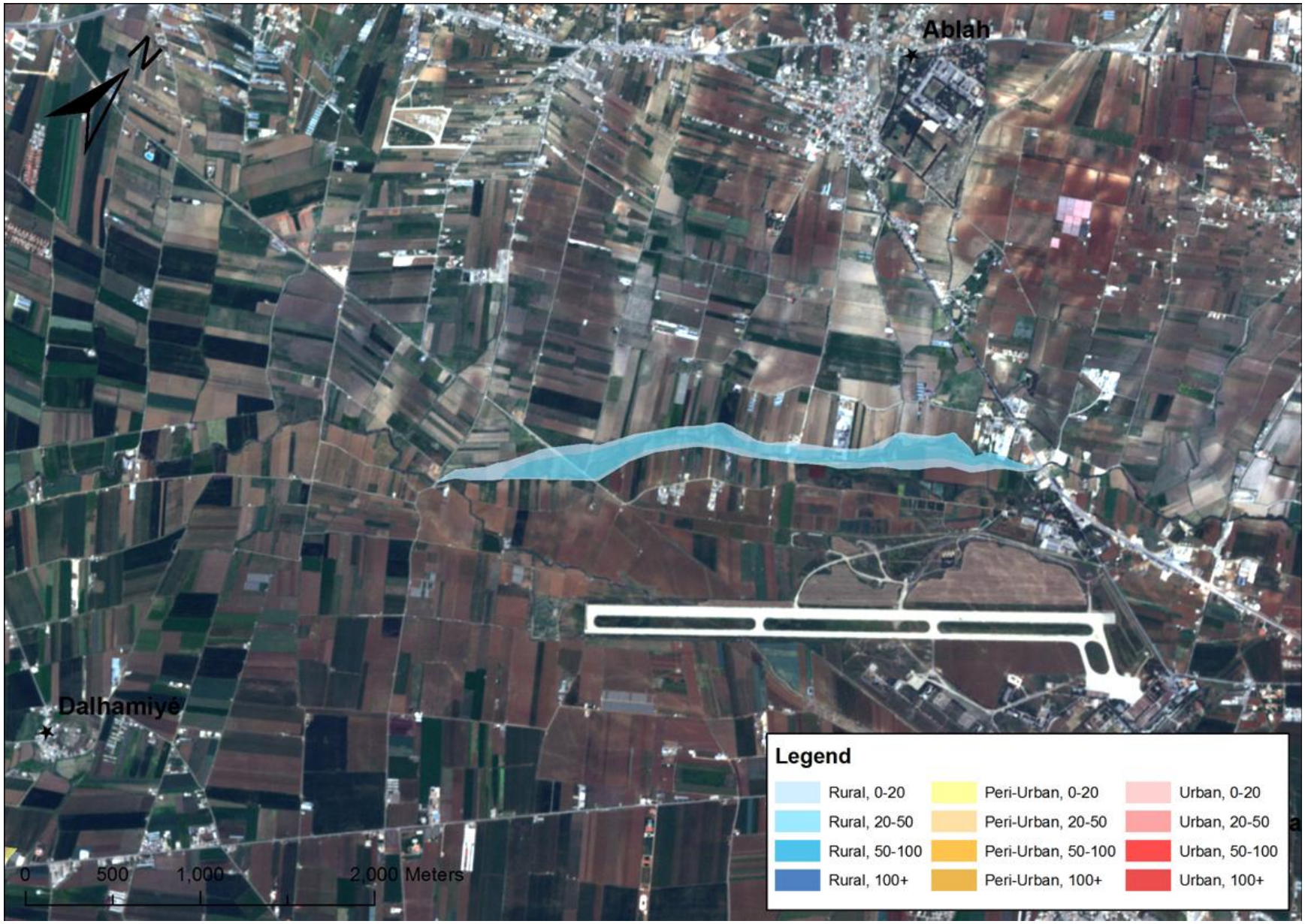
Sector	Solution	Cost
Region between Dalhamieh and Bar Elias	• Cleaning and Widening of Howayzek (4-5 km). • Reconstruction of Culvert on Howayzek near Bar Elias. • Construction of Levee (4-5 km) on Litani Left Side.	450,000 US$
Region of El-Marj on the right bank of Litani River	• Adding 1.5 to 2 km of Levees on both sides of the Chtaura River. • Adding 2.5 to 3 km of Levees on both sides of the Berdawni River.	450,000 US$
Region of El Marj on the left bank of Litani River	• Adding 3 to 4 km of Levees on the left side of the River.	200,000 US$
Region of Rawda on the left bank of Ghzayel River	• Adding 2-3 km of Levees on the left side of the River.	150,000 US$
Haouch El Harimeh at the left Bank of Faregh	• Cleaning and Widening of Faregh. • Building Bridges with adequate Section.	500,000 US$

Maintenance costs are not included here as riverbeds would have to be re-excavated on a regular basis (at least every 5 years).

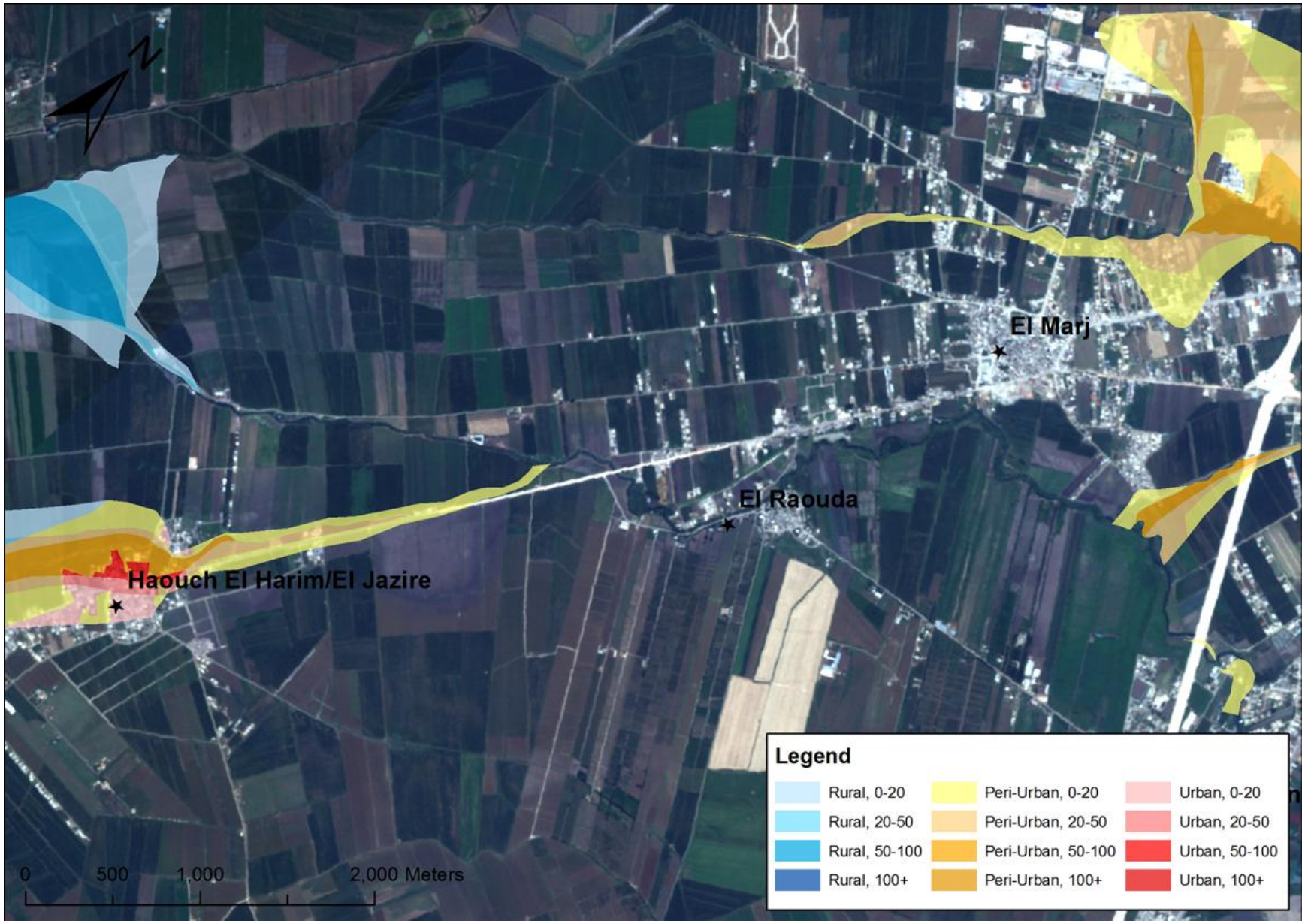
To justify the expenses, total costs have to be compared to actual flood damages. Such damages were estimated at $2-5M for 2003, with an annual probability of 1.5%, and thus an average yearly damage of $50-100,000.

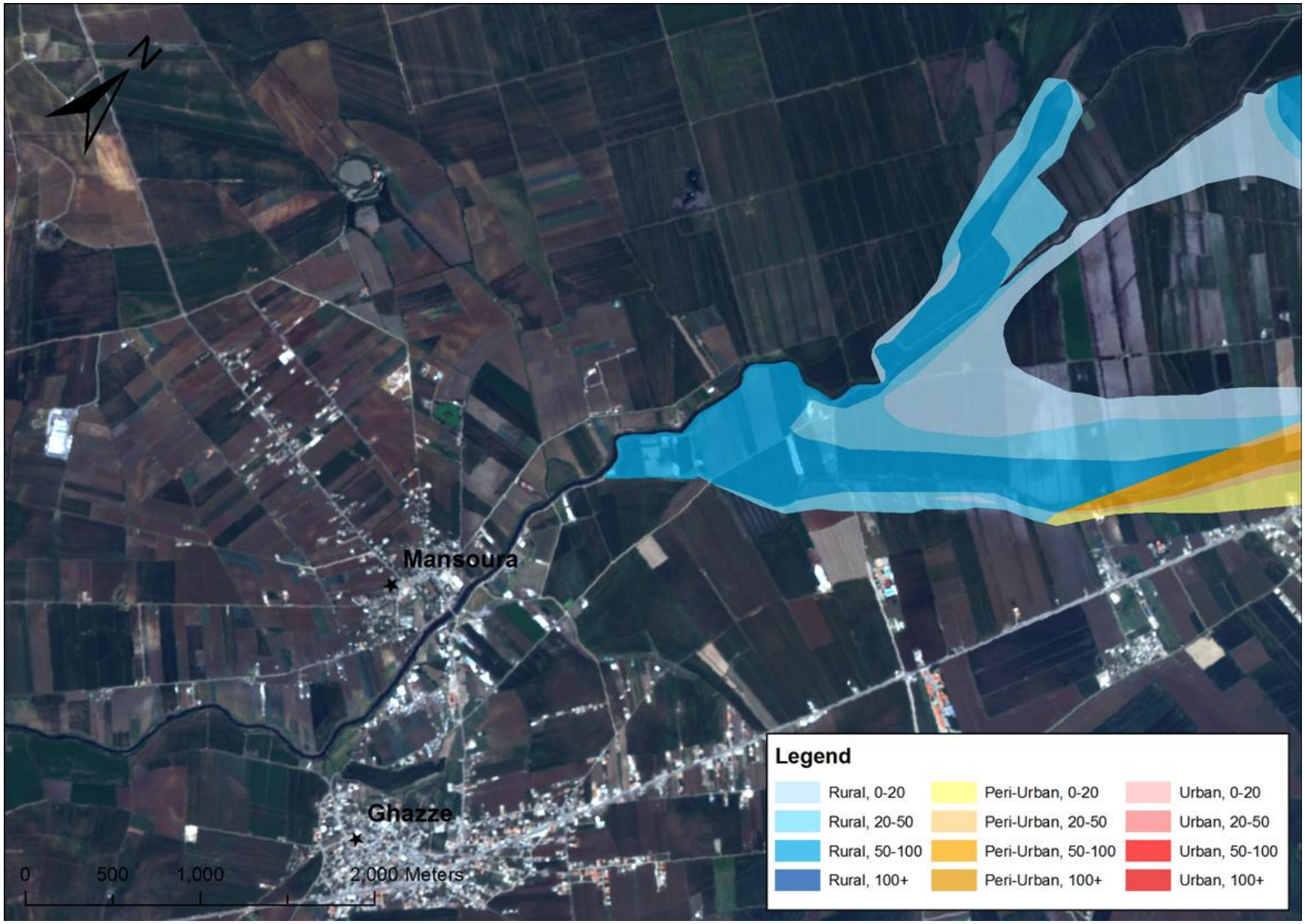
APPENDIX
FLOOD MAPS

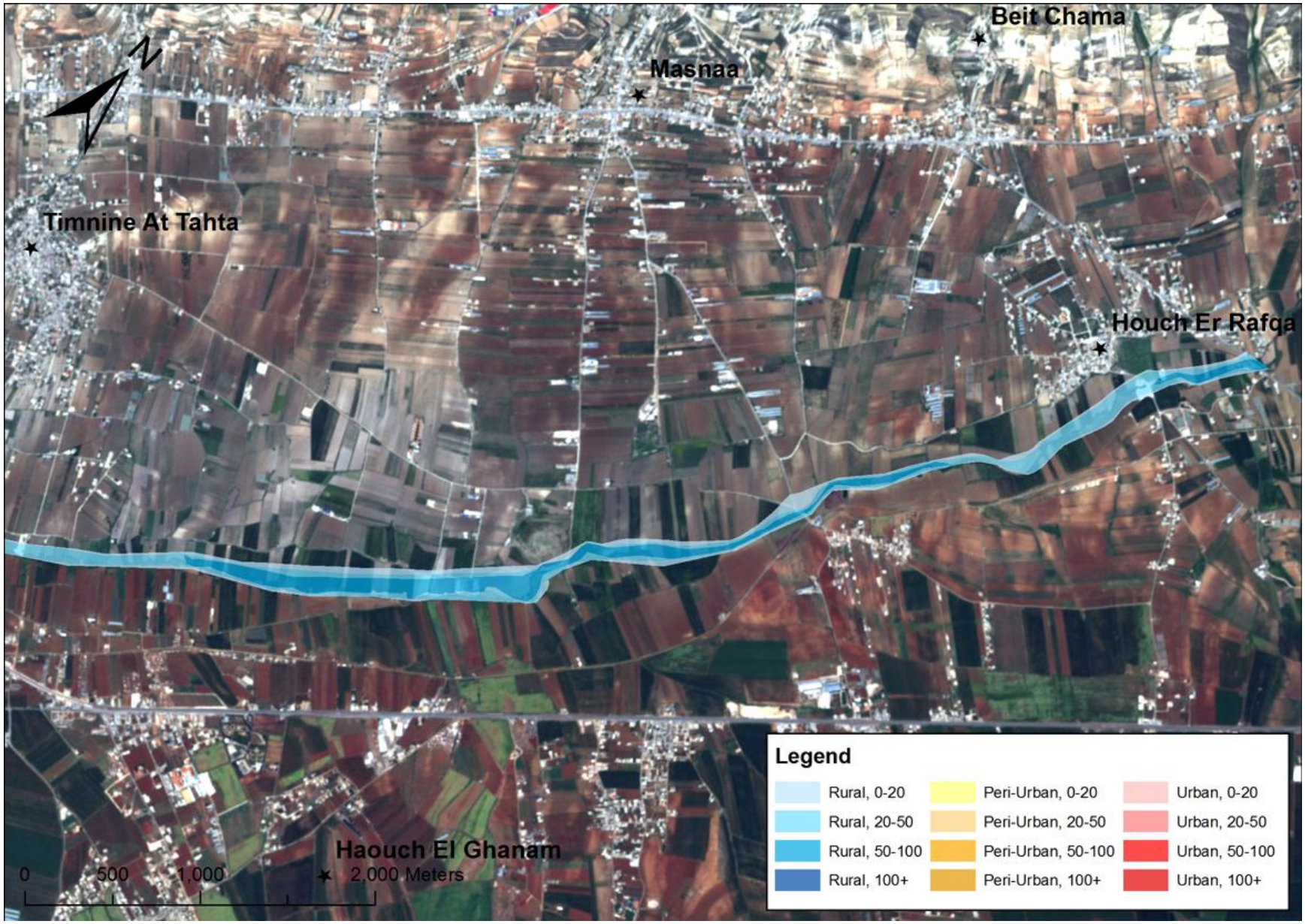

N
Beit Chama
Masnaa
Timnine At Tahta
Houch Er Rafqa
Haouch El Ghanam
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

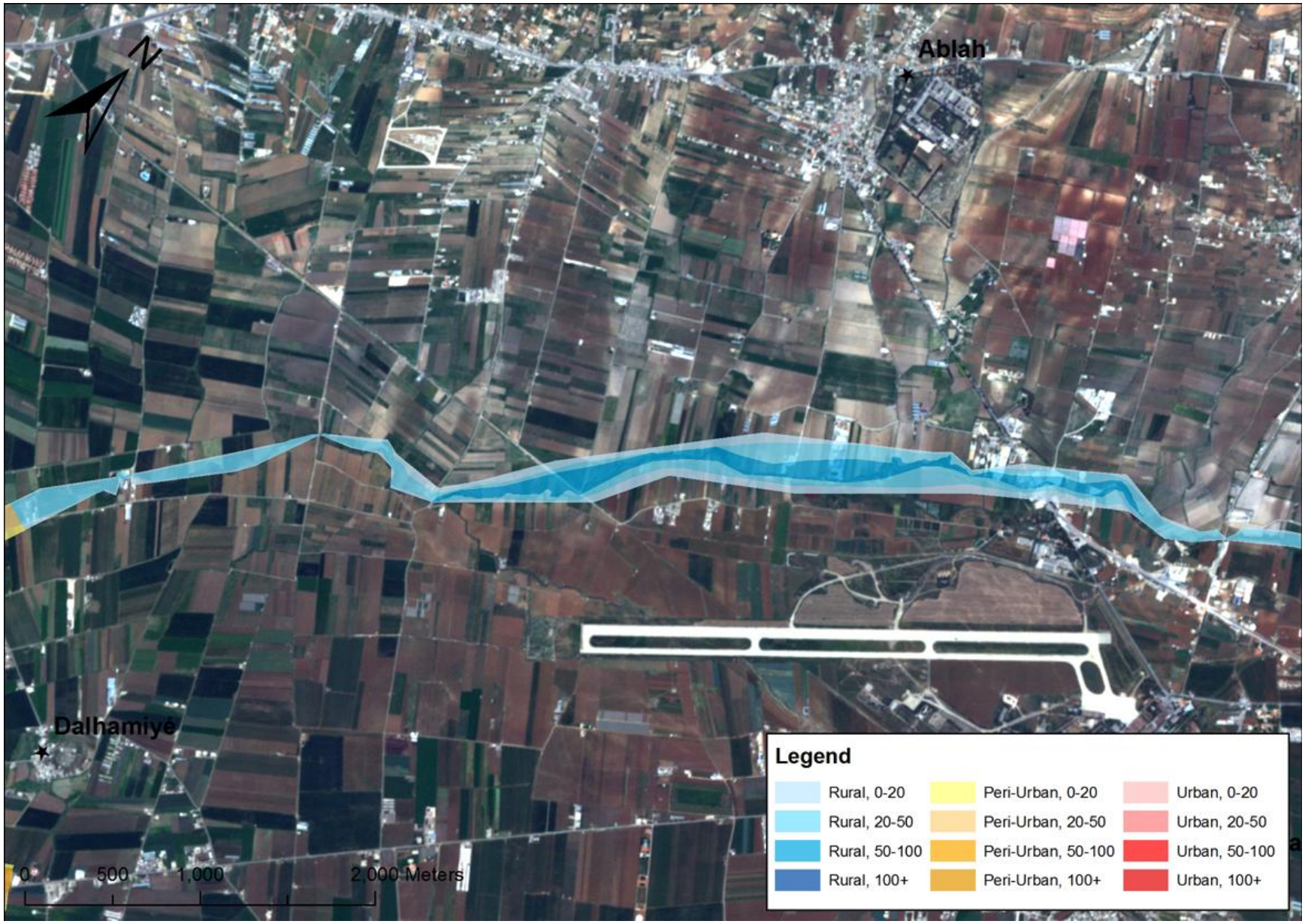

Ablah
Dalhamiyé
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+
0
500
1,000
2,000 Meters

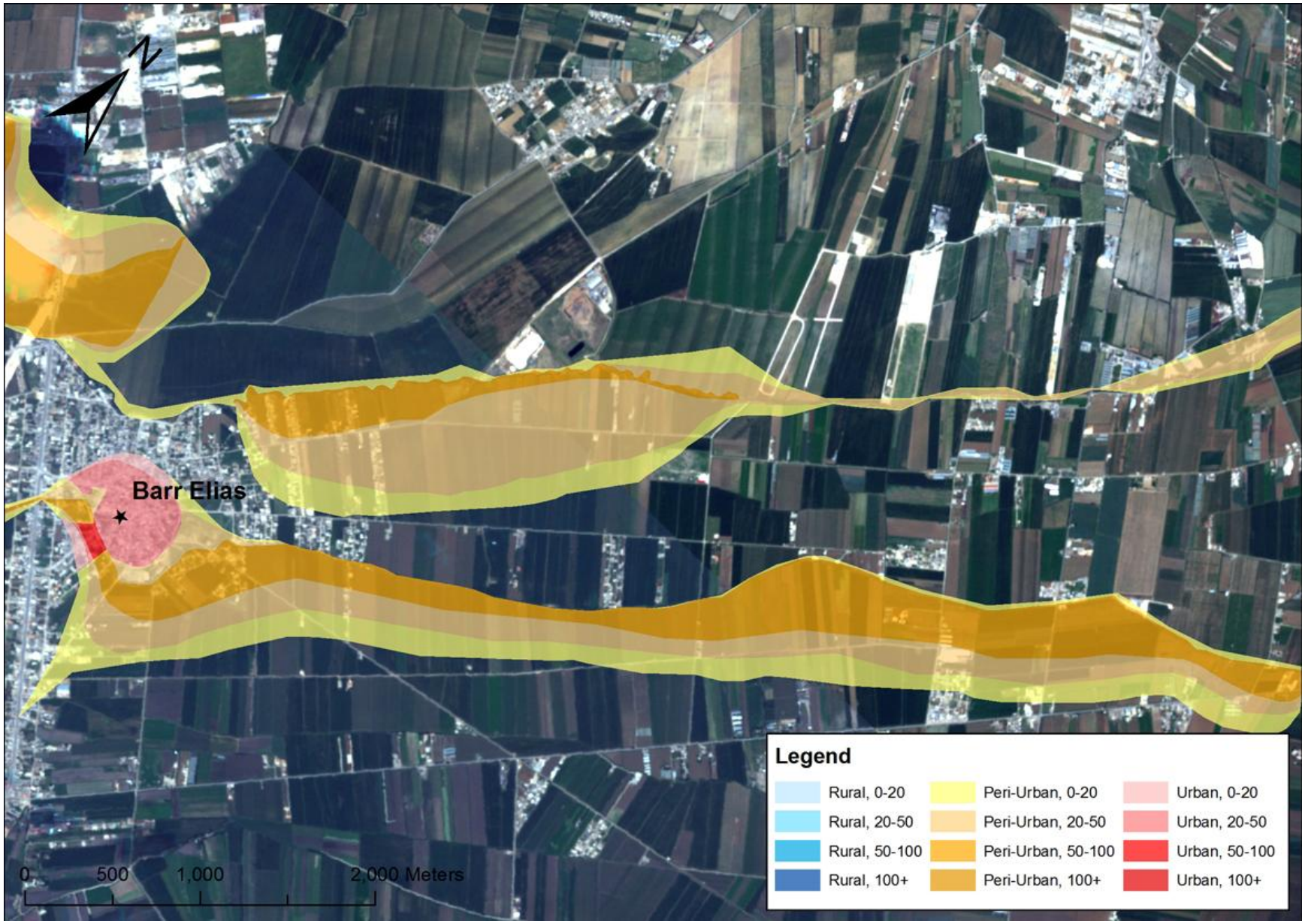

Barr Elias
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

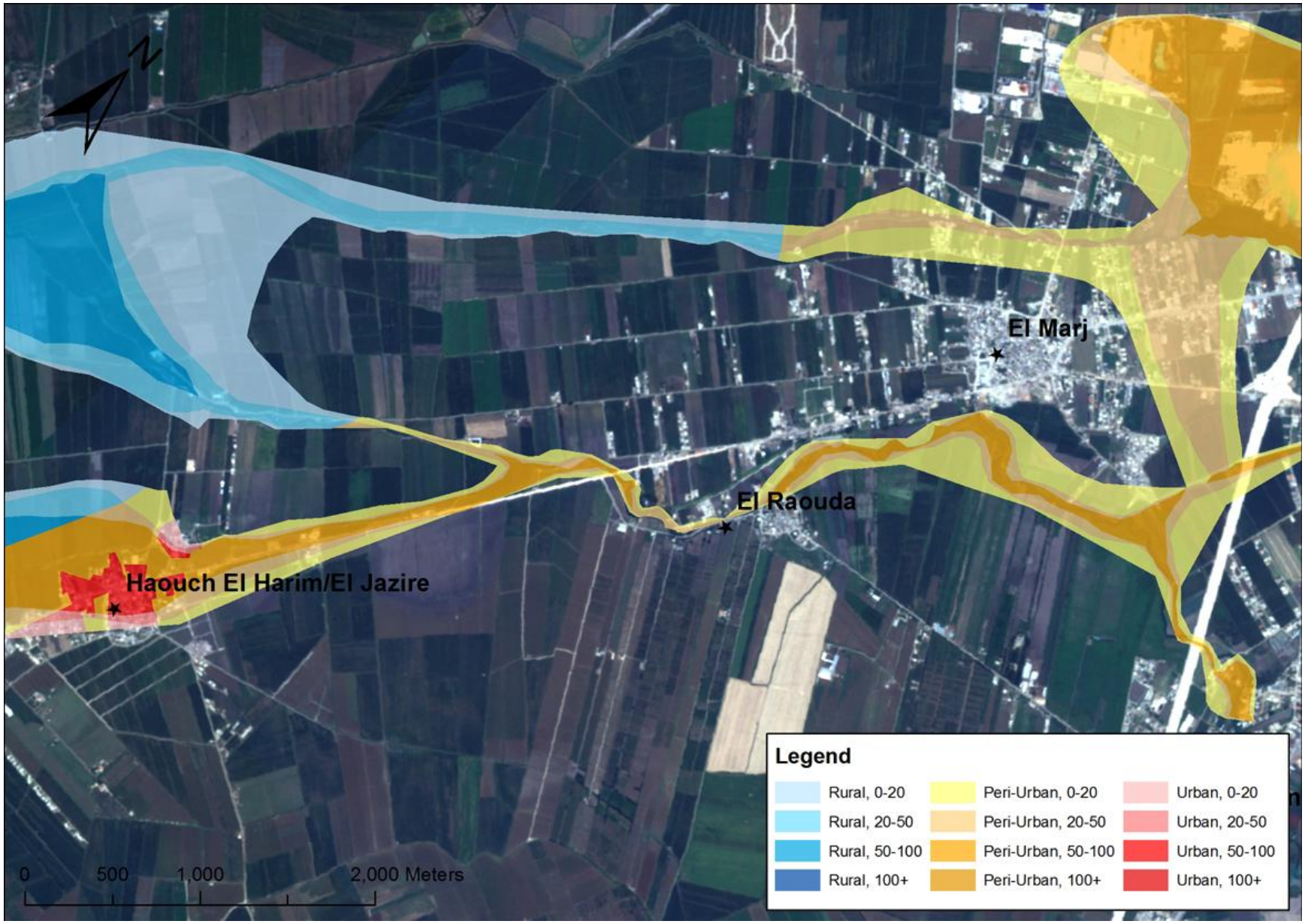

N
El Marj
El Raouda
Haouch El Harim/El Jazire
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+
0
500
1,000
2,000 Meters

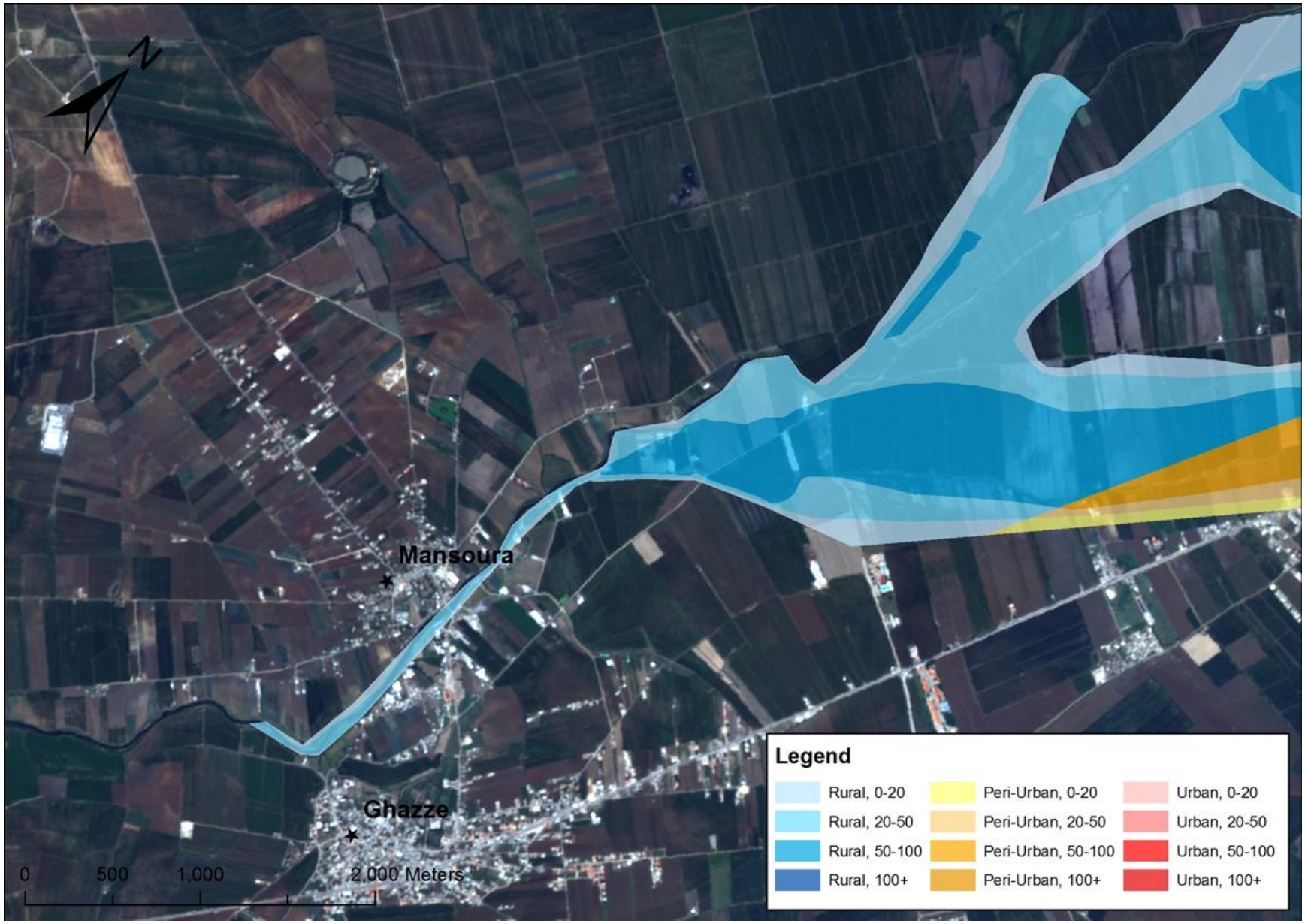

N
Mansoura
Ghazze
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

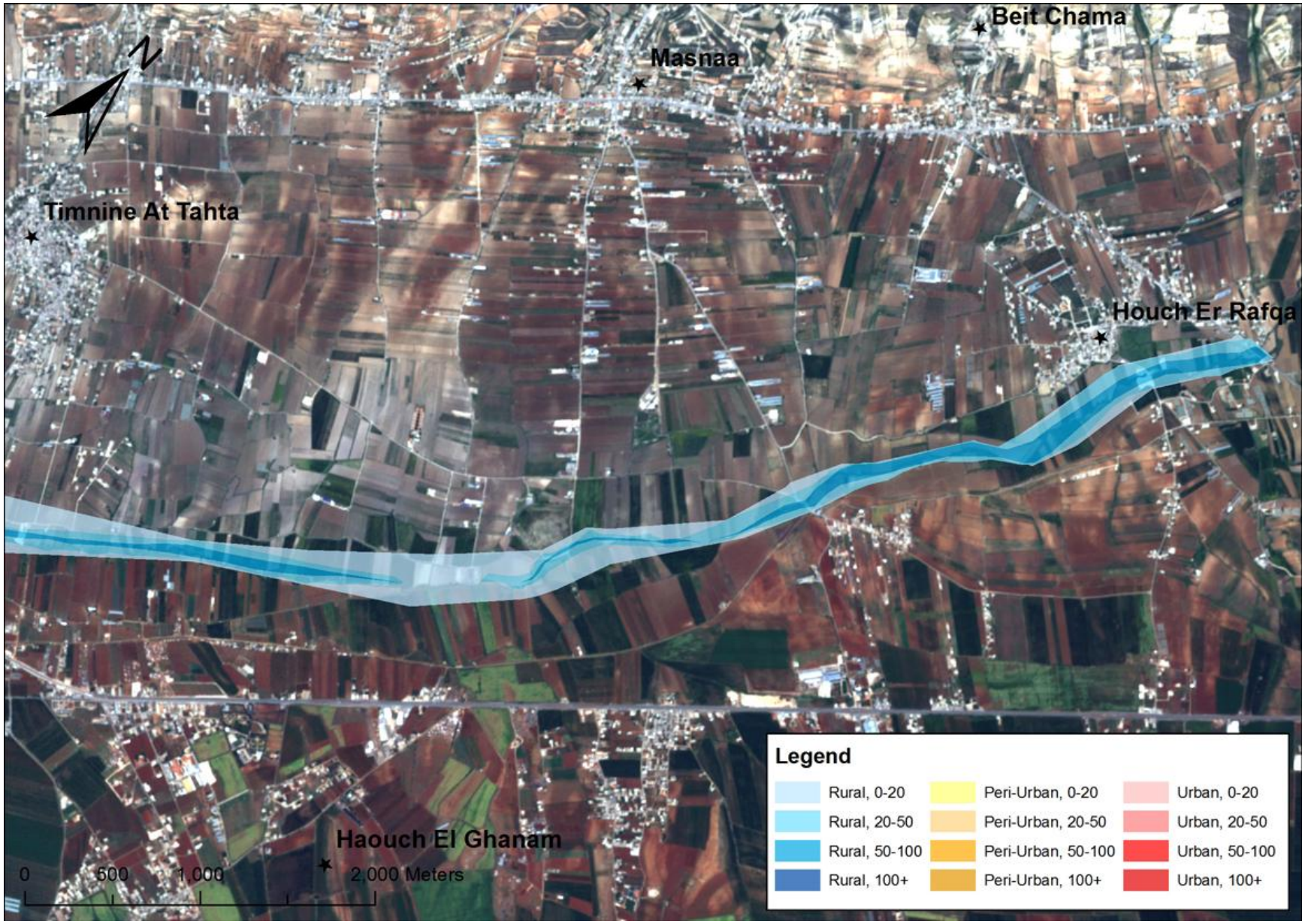

Beit Chama
Masnaa
Timnine At Tahta
Houch Er Rafqa
Haouch El Ghanam
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+
0
500
1,000
2,000 Meters

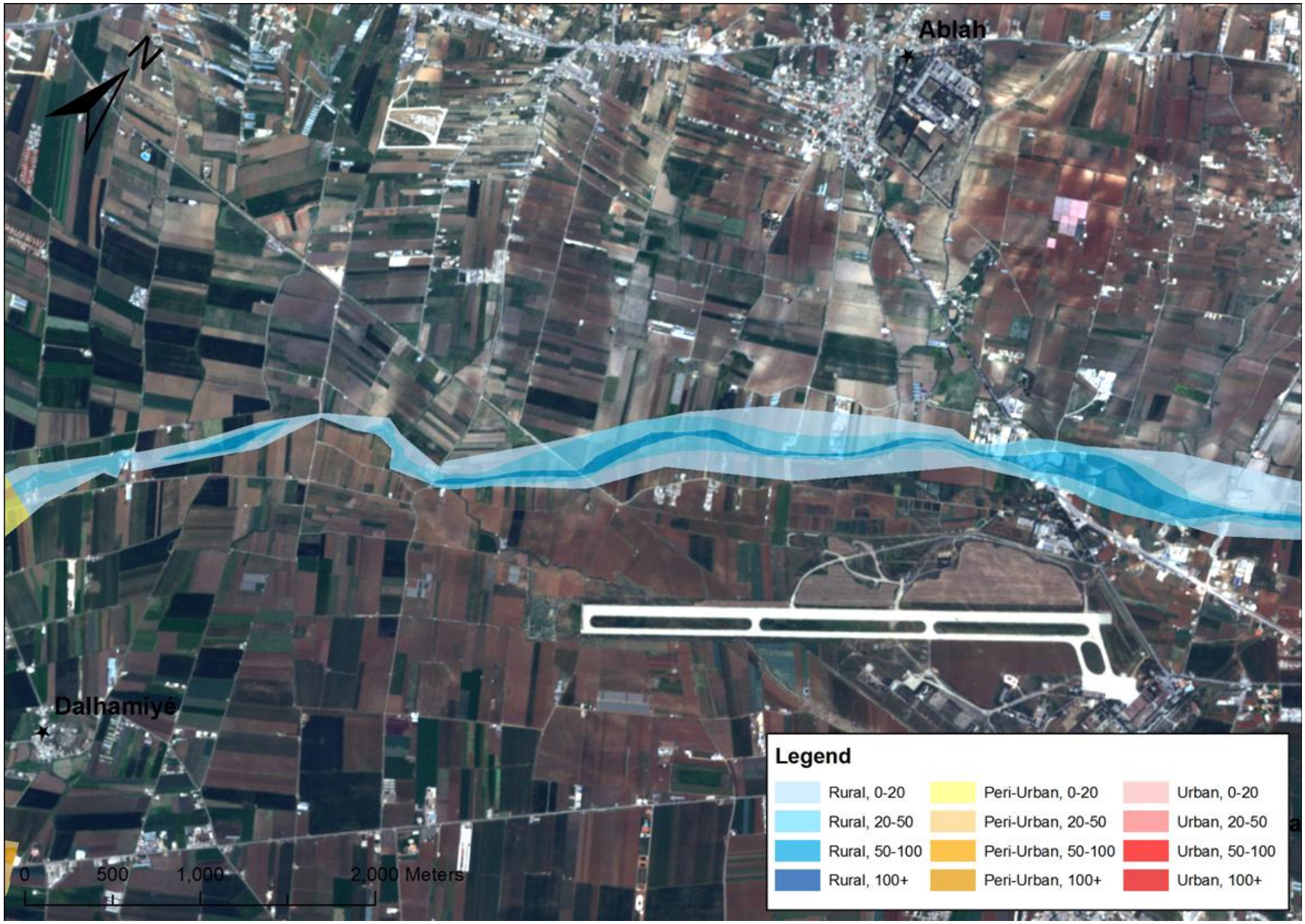

N
Ablah
Dalhamiyé
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

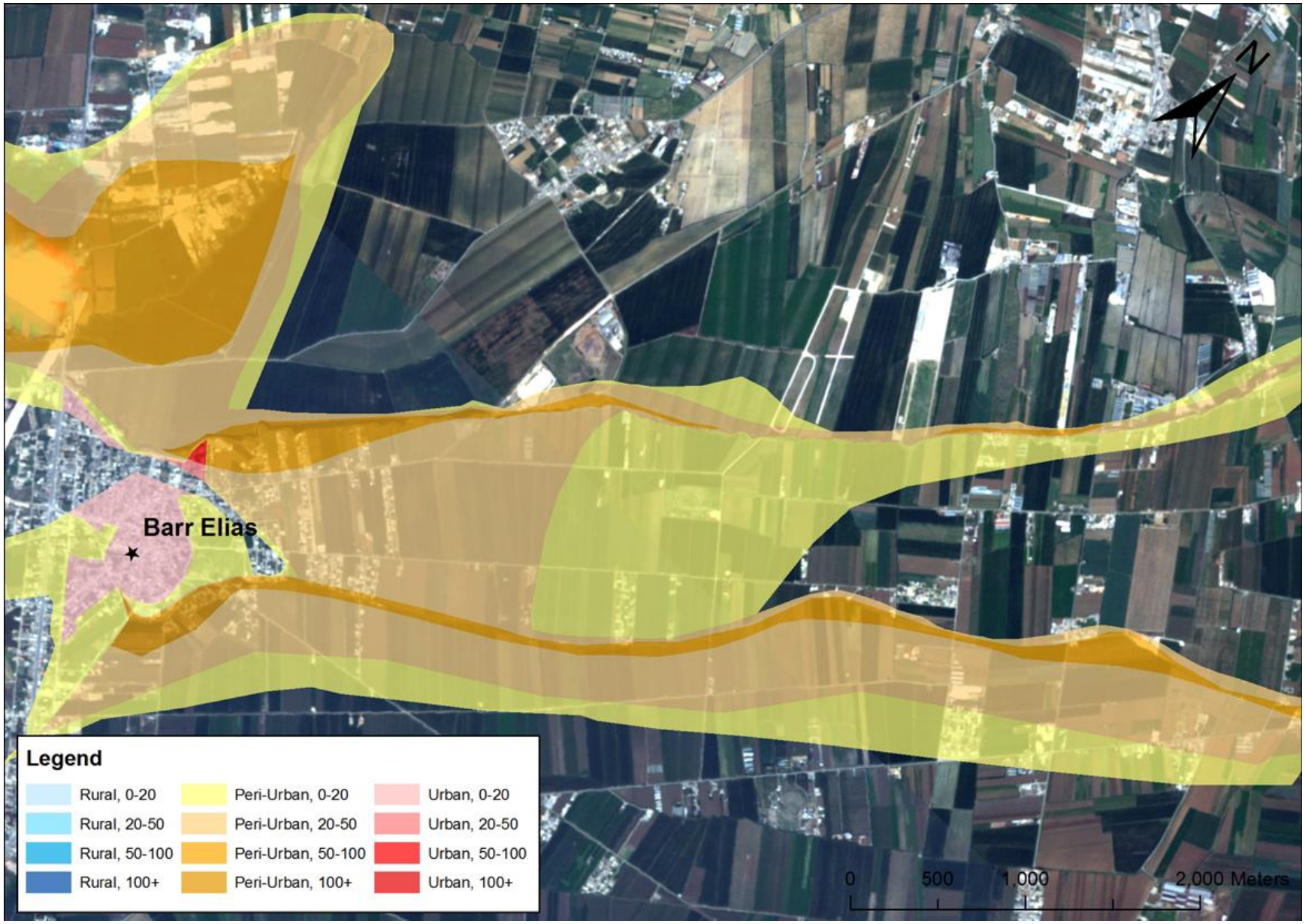

Barr Elias
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

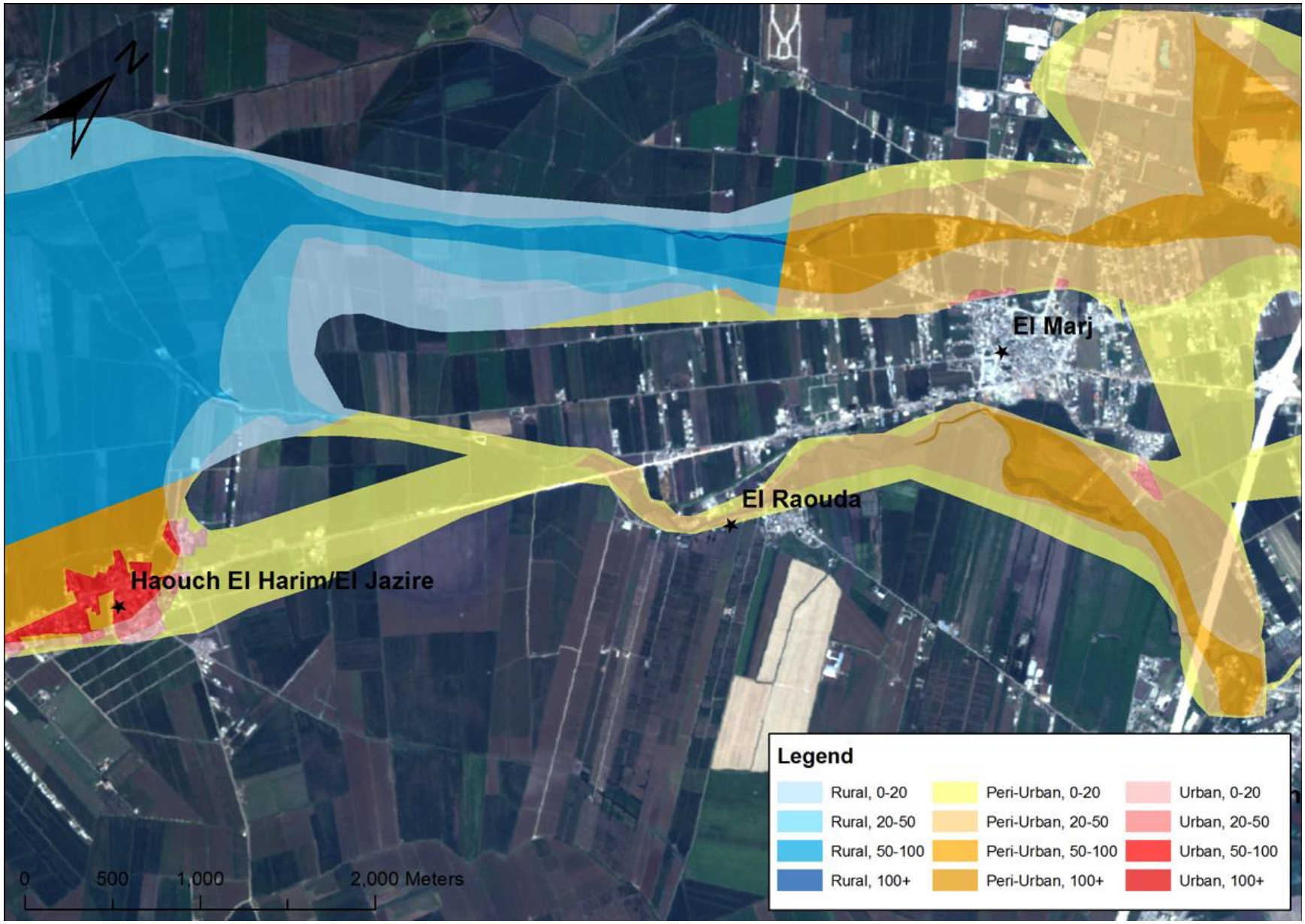

N
El Marj
El Raouda
Haouch El Harim/El Jazire
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

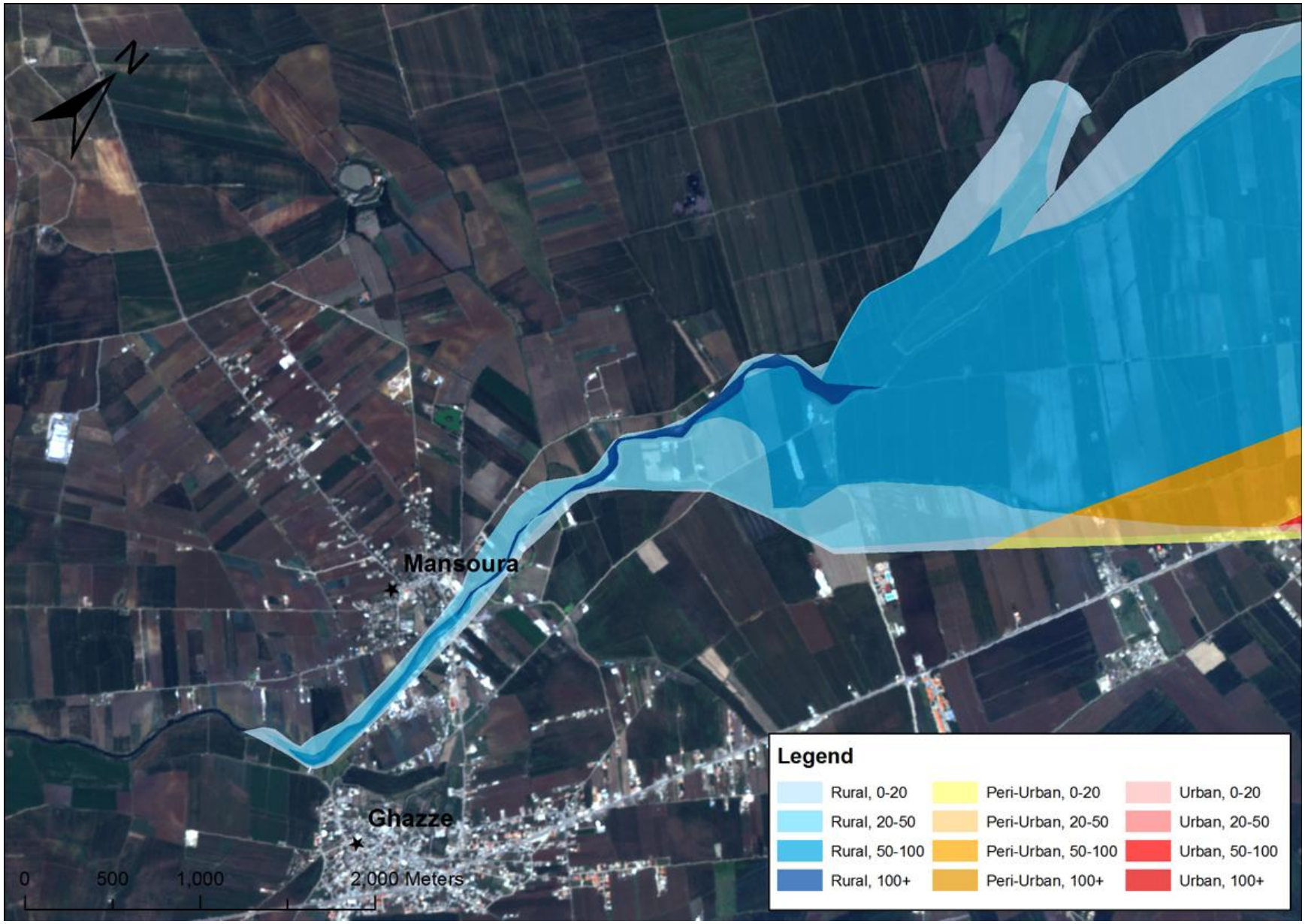

N
Mansoura
Ghazze
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+


Beit Chama
Masnaa
Timnine At Tahta
Houch Er Rafqa
Haouch El Ghanam
N
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+


Ablah
Dalhamiyé
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+
0
500
1,000
2,000 Meters


Barr Elias
N
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+
0
500
1,000
2,000 Meters


N
El Marj
El Raouda
Haouch El Harim/El Jazire
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+
0
500
1,000
2,000 Meters


N
Mansoura
Ghazze
0
500
1,000
2,000 Meters
Legend
Rural, 0-20
Rural, 20-50
Rural, 50-100
Rural, 100+
Peri-Urban, 0-20
Peri-Urban, 20-50
Peri-Urban, 50-100
Peri-Urban, 100+
Urban, 0-20
Urban, 20-50
Urban, 50-100
Urban, 100+

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov